# The Upper-Layer Circulation of the Japan Sea: Historical Data Analysis

Dr. Amy S. Bower
Department of Physical Oceanography, MS#21
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
phone: (508) 289-2781 fax: (508) 457-2181 email: abower@whoi.edu
Award #: N00014-98-1-0184
http://science.whoi.edu/users/abower

## LONG-TERM GOAL

The circulation of the Japan Sea is characterized by significant temporal and spatial variability due to several factors, including seasonal fluctuations in the warm inflow through Tsushima Strait, branching of the Tsushima Warm Current downstream of the strait, and the formation of mesoscale eddies along these branches. The long-range objective of the present study is to understand the dynamical processes that govern this variability.

## OBJECTIVES

Our objectives are to:

1. Describe the synoptic three-dimensional structure of the branching of the Tsushima Warm Current and its seasonal variability.

2. Describe the spatio-temporal modes of variability in dynamic height and determine the primary sources of this variability.

3. Provide a better description of the origin of the Tsushima Warm Current in the East China Sea and seasonal variability in its T-S characteristics.

## APPROACH

We are using historical hydrographic data from Dr. Alison Macdonald's North Pacific climatology and the vast XBT/AXBT data set from NAVOCEANO to investigate the seasonal variability in dynamic height in the Japan/East Sea. A method developed by Lagerloef (1994) is being used to convert temperature profiles to dynamic height profiles. Modal analysis of the dynamic height fields will follow, with comparisons to the wind fields. We will also use the repeated, synoptic AXBT surveys archived at NAVOCEANO to investigate the synoptic circulation in the upper Japan Sea.

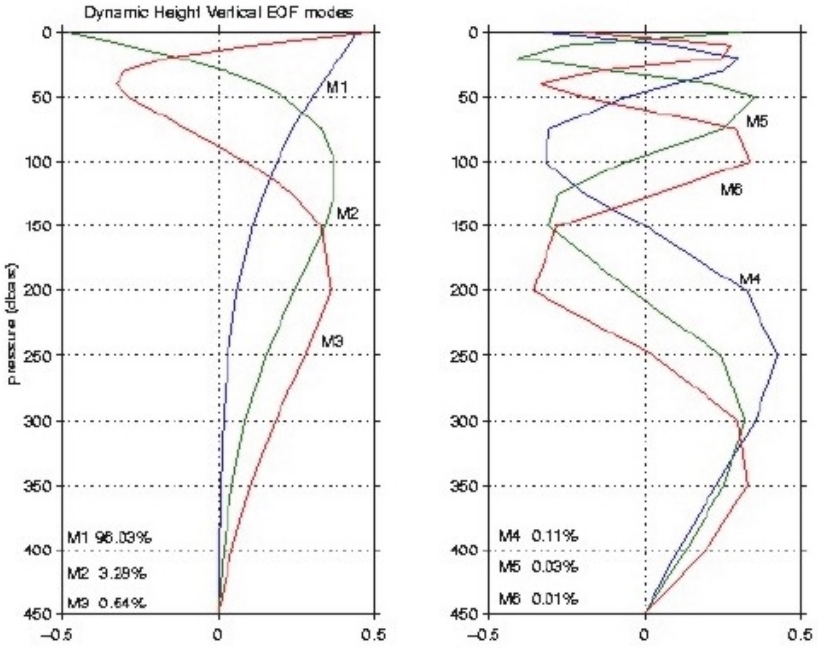
## WORK COMPLETED

This year we continued with the organization and assessment of the NAVOCEANO data. Since Dr. Alison Macdonald recently completed a North Pacific climatology (which includes the Japan Sea), we decided to use that data set as our hydrographic data base rather than going through the extremely

time-consuming quality control of the NAVOCEANO T-S data. We have started the analysis of the seasonal variability in dynamic height based on the XBT/AXBT profiles.

## RESULTS

This year we implemented the method of Lagerloef (1994) for converting temperature profiles to dynamic height profiles. A preliminary EOF analysis of dynamic height profiles obtained from the hydrocast data shows that almost all the variability is contained in a mode that resembles the first baroclinic mode in its vertical structure (see below). This is similar to what Lagerloef (1994) found in the Gulf of Alaska.




***The figure above shows the modal structure of the dynamic height profiles 1 through 6 from the hydrocast data of the Japan Sea. By combining these six modes, we incorporate >99.9% of the dynamic height variability into the conversion method. Dynamic height profiles were then estimated using Lagerloef's conversion method on the temperature profiles from the hydrocast data. A comparison of estimated versus true dynamic height yields an RMS error of 0.0191 dynamic meters, significantly better than other dynamic height estimation methods (see Lagerloef, 1994). A histogram of the error (not shown) indicates normal distribution of the errors, and a plot of estimated versus true dynamic height (not shown) shows a strong trend along the line of unit slope.***

## IMPACT/APPLICATIONS

Our results will provide a better description of the seasonal variability in the upper-ocean circulation of the Japan/East Sea and its causes. We will also shed light on the seasonal dependence of the branching of the Tsushima Warm Current downstream of Tsushima Strait, and the branching of the Kuroshio and its role in setting the T-S properties of the flow into the Japan Sea.

## RELATED PROJECTS

We plan to collaborate with other PIs working within the Departmental Research Initiative in the Japan Sea. Our work will relate particularly to that of Drs. Watts and Wimbush who will be making new observations of the mesoscale variability in the southern Japan Sea.

## REFERENCES

Lagerloef , G. S., 1994. An alternate method for estimating dynamic height from XBT profiles using empirical vertical modes. *Journal of Physical Oceanography*, **24**, 205-213.